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Life history of *Tetragnatha praedonia* (Araneae: Tetragnathidae)

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Abstract — The life history of a tetragnathid species, *Tetragnatha praedonia* was studied by both periodical field collectings and rearing spiders in the laboratory. Newly hatched spiderlings emerged repeatedly between June and September. Five spiders (two males and three females) were reared to adulthood. The developmental time from emergence to the adult molt was 57–59 days for males and 47–51 days for females. The repeated emergence of newly hatched spiderlings and the short life span suggest that *T. praedonia* has a turnover rate of a few generations per year.

Key words — Life history, *Tetragnatha praedonia,* multivoltinism, short life span, generation overlap

Introduction

Tetragnatha praedonia (Tetragnathidae) is a habitat generalist (Shinkai & Takano 1984, 1987; Yaginuma 1965, 1986) that is found in wet areas including ponds, marshes, streams (Shinkai & Takano 1984, 1987; Yoshida 1981, 2001), and paddy fields (Hamamura 1969; Okuma 1977), as well as in dry habitats including grasslands and gardens (Yoshida, unpublished data). This species sometimes constructs webs around outdoor lights and preys on insects that are attracted to such lights (Yoshida, personal observation). *T. praedonia* also inhabits unstable and/or disturbed habitats such as isolated shoals in rivers (Yoshida 1995) and paddy fields (Hamamura 1969; Okuma 1977), suggesting that this species has evolved a life history strategy suitable for persisting in such habitats, such as a short life span. However, life history of the species in the wild is very poorly studied although its effective accumulated temperature is known by rearing experiment (Kiritani 2001).

I investigated the life history of this spider species by collecting specimens from riverbanks and by rearing spiders in the laboratory. Based on the results, I discuss the life history characteristics of *T. praedonia* in relation to its habitat preferences.

Methods

Individuals of *T. praedonia* were collected from the banks of the Shizuhara River, a branch of the Kamo River in Kyoto, Japan, at approximately 1-month intervals between October 1990 and October 1991 and between April and October 1994. Each sampling event involved beating shrubs and herbaceous vegetation 200 times with a stick. Spiders dropping into an umbrella (50 cm in diameter) that was held upside down, were collected by using a pooter. Not only *Tetragnatha praedonia* but also *T. maxillosa* were collected in the study area, and they resembled one another especially when young. I distinguished *T. praedonia* from *T. maxillosa* by the presence of: 1) two pairs of yellow spots near spinnerets, 2) anterodorsally elevated abdomen, 3) a pair of yellow-green belts longitudinally stretched over the ventral surface of abdomen in *T. praedonia* (in *T. maxillosa,* the underside of abdomen is entirely black or dark brown). The carapace length of each individual of *T. praedonia* was measured under a binocular microscope in the laboratory.

I collected several cocoons of *T. praedonia* on 18 June 2000 in Kagoshima Prefecture, southernmost Kyushu. Spiderlings emerged on 26 June 2000. I selected 10 individuals and reared them individually in glass tubes. I first offered them conspecific spiders and various insects including mayflies, caddisflies, and midges. Rearing was conducted at room temperature.

Results

During the field survey between 1990 and 1991, individuals of *T. praedonia* collected per sampling event were few until May of 1991. The number of individuals increased in June due to the emergence of newly hatched spiderlings of less than 0.9 mm in carapace length. Number of individuals peaked in August and then decreased again. In 1994, there was a rapid increase in June, but the population reached its peak in September (Fig. 1).

Figure 2 shows the seasonal change of the carapace length distribution of *T. praedonia.* Winter populations consisted of various sizes of nymphs. In 1991, the size distribution of *T. praedonia* shifted to larger individuals from March to May, probably due to the growth of spiders. Adults first emerged on 22 May. Many newly hatched spiderlings ($<$0.6 mm carapace length) emerged on 19 June and comprised 65.2% (103 individuals) of the population. Larger spiderlings (0.9–1.2 mm) observed in the sample

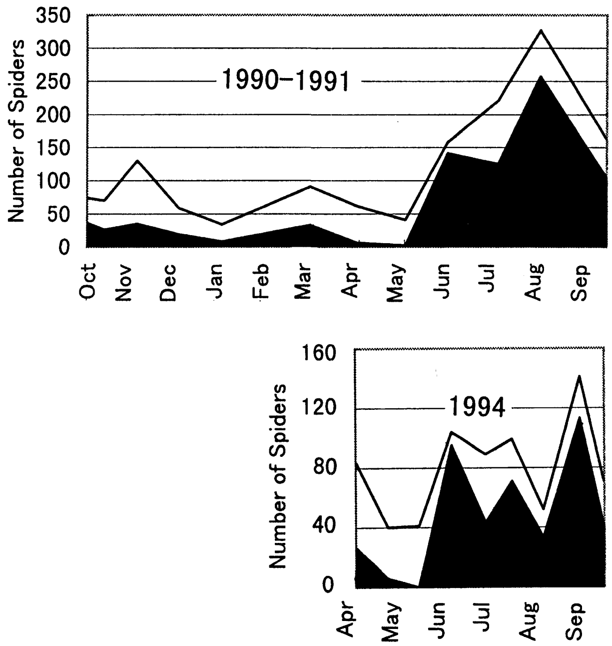

Fig. 1. Seasonal change in the number of *Tetragnatha praedonia* collected by 200-times beating. Shaded areas show individuals less than 0.9 mm in carapace length.

were probably individuals born earlier in the same year. Another peak of spiderlings less than 0.6 mm was found on 20 August (225 individuals, 68.8%). Such small spiderlings were relatively less abundant on 23 July (38.9%) and on 3 October (36.6%). Adults were collected until 20 August, but no adults were observed on 3 October (Fig. 2a). In 1994, the size distribution of *T. praedonia* shifted to larger individuals from 22 April to 3 June. There were three peaks in the number of spiderlings less than 0.6 mm: 25 June (76 individuals, 73.1%), 5 August (64 individuals, 64.6%), and 20 September (95 individuals, 67.4%). In contrast, such small spiderlings represented relatively lower percentages on 18 July (32.6%), 26 August (44.2%), and 6 October (32.4%). Adults were collected on 20 September and on 6 October in 1994 (Fig. 2b).

Five spiders (two males and three females) were reared to adulthood (Fig. 3). The duration required for females and males from hatching to the final molt were 47–51 and 57–59 days, respectively. The carapace length of adult females reared (mean $\pm$ standard deviation $= 2.7 \pm 0.1$ mm, N=3) was smaller than that of adult females collected in fields (3.5 ± 0.4 mm, N=55) (t-test, df=5, p=0.0001). The carapace length of adult males reared (mean $\pm$ standard deviation $=$ 2.7 ± 0.0 mm, N=2) seemed also smaller than that of adult males collected in fields (3.2 ± 0.4 mm, N=26), though the difference was insignificant probably due to the paucity of the samples.

One of the three females constructed a cocoon without mating at the age of 60 days·after emergence. All of the spiders reared molted 5–8 times before maturation. Because I was unable to collect shed exoskeletons of individual spiderlings, the number of times spiders molted between emergence and maturation may have been underestimated.

Discussion

The repeated increase of small spiderlings in 1991 and 1994 may suggest that *T. praedonia* produces two or more generations per year. The result of rearing experiment also seems to support the estimate. Okuma (1977) also suggested that *T. praedonia* as well as *T. maxillosa* has a multivolutine life cycle in Fukuoka City, judging from the repeated increase of spiderlings and the result of rearing experiment of *T. maxillosa*.

T. praedonia can grow at >9℃ and the effective accumulated temperatures for this species to mature is ca. 820 days-℃ (Kiritani 2001). The total effective accumulated temperatures in a year is calculated as 2,673 days-℃ in Kyoto from the data on the seasonal change in the average temperature between 1961 and 1990, cited from the home page of Kyoto Meterological Agency. This value is 3.3 times of the effective accumulated temperature for *T. praedonia*. So, this species can theoretically produce three generations per year. But, it may be cooler in the study area than at Kyoto Meterological Agency, since the study area is among rice fields near mountains whereas the agency is at a residential area. If the temperature were 3℃ lower as a probable approximation at the study area than at the meterological agency, the total effective accumulated temperatures is calculated as 1,982 days-℃ in the study area. This value is 2.4 times of the effective accumulated temperatures to mature.

As shown in the results, many newly hatched spiderlings (<0.6 mm carapace length) emerged in late June. If the temperature at the study area is 3℃ lower than at the Kyoto Meterological Agency, spiderlings emerged in late June will mature in mid-August, judging from the effective accumulated temperatures. It takes ca. 55 days to mature in the season. Thus, the adult females born in June will make cocoons in August or September (summer generation). But, spiderlings hatched in late August or September will be unable to reach adulthood before the onset of a winter because of the shortage of the effective accumulated temperatures. They will overwinter as juveniles, and will mature in May or June (winter generation). As *T. praedonia* makes webs at warm days even in winter (Yoshida, personal observation), it probably does not hibernate.

But, the generations seemed to overlap, because at any given time I found various sizes of individuals. Thus, it appears that breeding seasons of *T. praedonia* are not limited in a short period, and eggs may be laid continuously from June to September. Such overlapping is also reported in other species (Cho 1982; Sato 1984; Miyashita 1992). Two explanations may be possible for the generation overlap. First, there may be a large variation in the developmental time from emergence to adult molt. Spiders mature and become larger adults in a shorter period when they are given more prey (Miyashita 1968; Sato 1985; Vollrath 1987).

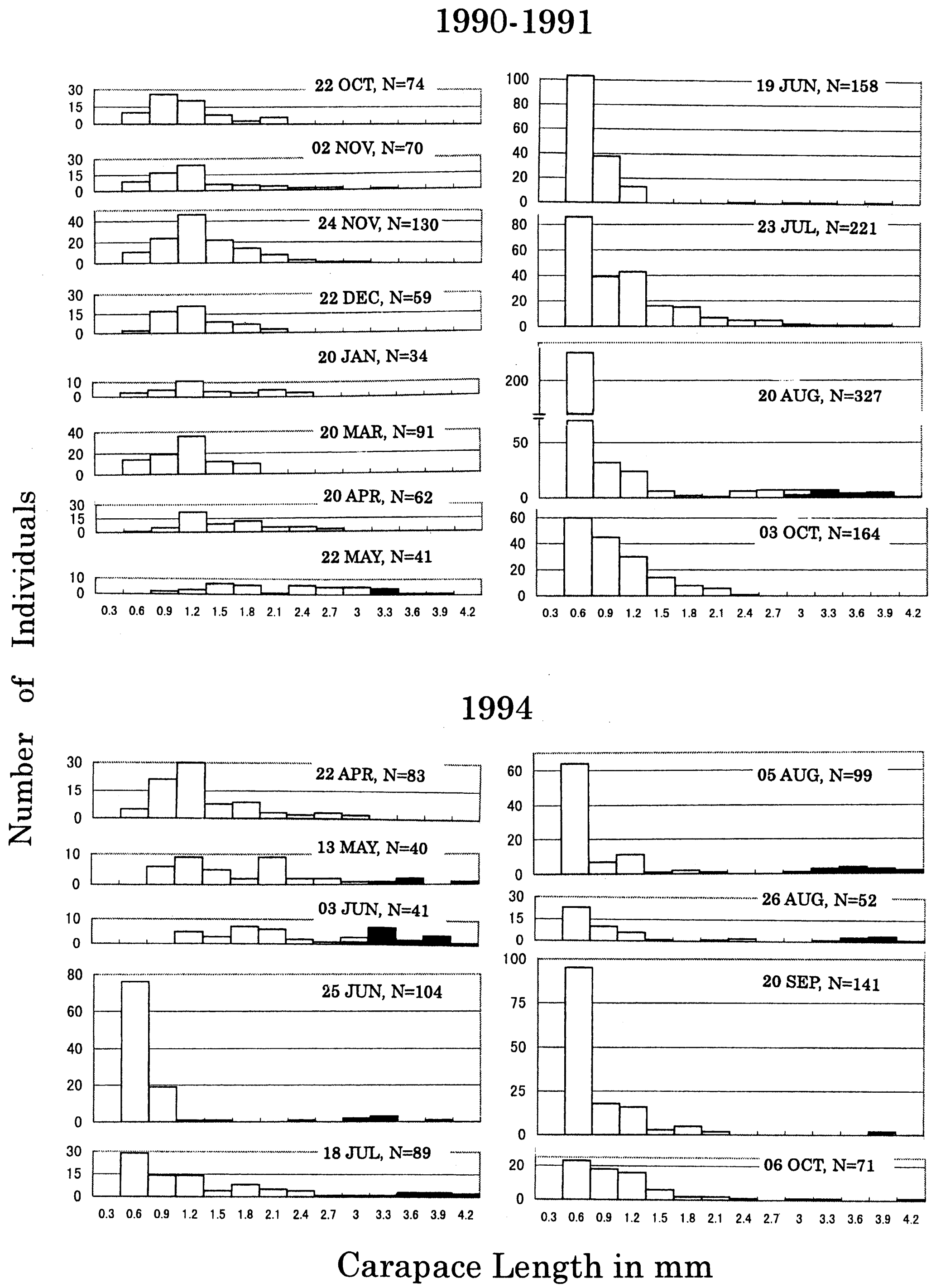

Fig. 2. Seasonal change in the carapace length distribution of *T. praedonia*. Numerals of the abscissa show the size classes (for example, "0.6" is the size class 0.3–0.6 mm in carapace length). Solid areas show adults.

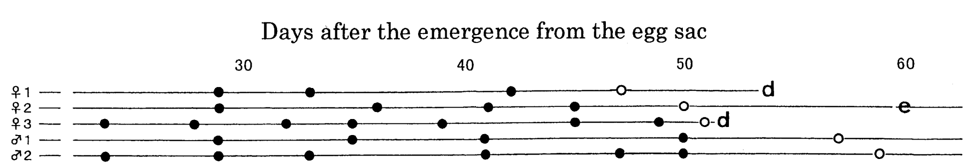

Fig. 3. Development of *T. praedonia* reared in laboratory. Each line shows each individual. Solid circles and open ones show nymphal and the ultimate molt, respectively. "d" and "e" show the death and egg-laying, respectively.

Therefore, well-fed spiders may mature more rapidly and lay eggs earlier, whereas poorly-fed spiders may mature more slowly and lay eggs later. Since adults of *T. praedonia* collected in fields were larger than those reared, most individuals may mature earlier in nature. Second, females may oviposit successively. LeSar and Unzicker (1978) stated that most *T. laboriosa* made two cocoons in rearing conditions. Adult female *T. praedonia* may not die after the first oviposition, but may lay eggs successively for a few months. To verify this possibility, it would be necessary to rear adult female *T. praedonia.*

This type of life history strategy may be profitable for spiders that inhabit unstable or disturbed habitats such as paddy fields or isolated shoals in rivers. Shoals are flooded and/or destroyed by heavy rains at irregular intervals. *T. praedonia* was one of the most common species found on an isolated shoal (Yoshida 1995), probably because its life span is short. The linyphiid spider *Erigonidium graminicola,* which has several generations a year (Cho 1982), was also a dominant species in this habitat (Yoshida 1995). Paddy fields have a rich fauna of terrestrial arthropods (more than 450 species; Kobayashi et al., 1973), so many prey species are available for spiders in spring and summer. On the other hand, in autumn and winter, paddy fields are difficult for spiders to inhabit because the rice plants have been harvested. However, spiderlings of *T. praedonia* born in June probably can mature and lay eggs before the harvest.

Acknowledgments

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Acta Arachnologica Vol. 51, No. 1 掲載論文の和文要旨

アシナガグモの生活史（pp. 1–4）

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野外調査と飼育によって，アシナガグモ（*Tetragnatha praedonia*）の生活史を調べた．野外では，新たに孵化したと思われる子グモが，6月から9月の間に繰り返し出現した．出のう直後から育てられた10頭のうち，5頭（オス2頭とメス3頭）が成体となった．出のうから最終脱皮までの期間は，オスでは57–59日，メスでは47–51日であった．新たに孵化した子グモの度重なる出現と短い生活史は，アシナガグモが年2–3世代の回転率をもつことを示唆している．

アカクモヒメバチによるサツマノミダマシへの寄生の初記録【短報】（pp. 5–6）

桝元敏也[1]，清水　勇[1]，小西和彦[2]（[1]〒522-2113 大津市上田上平野町字大塚 509-3　京都大学生態学研究センター；[2]〒062-8555 札幌市豊平区羊ヶ丘 1　独立行政法人　農業技術研究機構　北海道農業研究センター虫害研究室）

アカクモヒメバチ *Eriostethus rufus*（Uchida, 1932）は従来 *Araneus* 属のクモに寄生するとされていた．しかし，我々はこのハチが別属である *Neoscona* 属のクモに寄生することを発見した．アカクモヒメバチとその宿主であるクモとの関係は再検討する必要がある．

日本産ミジングモ亜科（クモ目：ヒメグモ科）の属および種の検討（pp. 7–18）

吉田　哉（〒990-2484 山形市篭田 2 丁目 7 番 16 号）

日本産のミジングモ亜科 Hadrotarsinae Thorell 1881 の属および種の検討をおこなった．この亜科の特徴は，雌の受精のうが2対で雌の触肢の爪が背腹方向に扁平，第1歩脚跗節腹面に特化した毛があることおよび糸疣前疣の中央に洗濯板状の突出部があることである．

すべての種に検討を加え，属の検索表を表し，日本から6属19種を記録した．このうち，ヤギヌマミジングモ属（新称）*Yaginumena* を新属として記載し，ツツミジングモ属（新称）*Trigonobothrys* Simon 1889 およびシロカネヒラタヒメグモ属（新称）*Emertonella* Bryant 1949 を属として復活した．さらに，アイチミジングモ属（新称）*Lasaeola* Simon 1881 に属する種を日本より記録した．これらの属に属する12種，ボカシミジングモ *Yaginumena castrata*（Bösenberg & Strand 1906），コアカクロミジングモ *Y. mutilata*（Bösenberg & Strand 1906），マダラミジングモ *Y. maculosa*（Yoshida & Ono 2000），オキナワミジングモ *Lasaeloa okinawana*（Yoshida & Ono 2000），ヨシダミジングモ *L. yoshidai*（Ono 1991），ヨナミジングモ *L. yona*（Yoshida & Ono 2000），ヤマトミジングモ *Trigonobothrys japonicus*（Yoshida 1985），アマミミジングモ *T. amamiensis*（Yoshida 1985），ホシミジングモ *T. martinae*（Roberts 1983），キベリミジングモ *T. flavomarginatus*（Bösenberg & Strand 1906），カニミジングモ *T. mustelinus*（Simon 1889）およびクロホシミジングモ *T. nigromaculatus*（Yoshida 1987）はミジングモ属 *Dipoena* Thorell 1869 より，さらに1種，シロカネヒラタヒメグモ *Emertonella taczanowskii*（Keyserling 1886）はヒラタヒメグモ属 *Euryopis* Menge 1868 より新たに属を移動した．また，タニカワミジングモ（新称）*Dipoena nipponica* を新種として記載した．さらに，中国で記載された *Dipoena immaculata* Zhu 1998 をキベリミジングモ *T. flavomarginatus* の，また北アメリカ産の種をタイプ種とする属 *Pselothorax* Chamberlin 1948 をアイチミジングモ属 *Lasaeola* の新参異名とした．フタホシヒラタヒメグモ *Euryopis iharai* Yoshida 1992 は所属が不明確のため本稿では除外した．

近畿地方でナス属を食害するナミハダニ属（ハダニ科）の1新種（pp. 19–22）

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大阪・京都両市の市街地でナス属（*Solanum*）の3種の植物（イヌホオズキ，ワルナスビおよびナス）に多発していたハダニを新種と認め，*Tetranychus takafujii*（ミツユビナミハダニ，新称）と命名・記載した（ホロタイプは大阪市福島区淀川河川公園のイヌホオズキから採集した♂）．本種は，国外の *T. evansi* Baker & Pritchard に最もよく似ているが，♂の第II脚の爪間体の形態で異なる．挿入器は国外産の *T. marianae* McGregor のそれにも似るが，♀♂の脚の形態で相違する．脚の毛の配列は日本のアシノワハダニにも類似するが，挿入器の形態で識別できる．このハダニは，日本国内でナス属の主な害虫の一つになる可能性を持っていると思われる．

中国のアシダカグモ科 2. 長春コレクションに含まれる種

Peter Jäger[1], Jiuchun Gao[2], Rui Fei[2]（[1]Institute für Zoologie, Johannes Gutenberg-Universität, Germany; [2]Jilin University, P. R. China）（pp. 23–31）

アシダカグモ科の2新種：*Sinopoda angulata* と *S. fasciculata* を記載した．*Pseudopoda* sp. cf. *exiguoides* と *Pseudopoda* 属の種名未決定種をそれぞれを湖南省と四川省から記録した．アシダカグモ *Heteropoda venatoria* を広東省と雲南省から記録した．ツユグモ *Micrommata virescens* を吉林省から初めて記録した．*Olios tiantongensis* を同種とみられる2雄をそれぞれ江蘇省と湖南省から記録した．*O. menghaiensis* を同種とみられる1♀を雲南省から記録した．*Eusparassus sanguinifrons* Simon 1906 の雌を初めて記載し，*Olios* へ転属した．全種の生殖器を図示した．（和訳：編集委員会）